

Base 10 (aka Decimal)

1	2	3
100	10	1
10^2	10^1	10^0

Notice we have 10 possible digits: 0 1 2 3 4 5 6 7 8 9

Notice, we start with the one's place and go up by multiples of 10 (hence base 10)

Base 2 (Binary)

1	0	1	0	1
16	8	4	2	1
2^4	2^3	2^2	2^1	2^0

Binary number 10101 = $16+4+1=21$

We have two possible digits: 0 1 (off on)

Notice, we start with the one's place and go up by multiples of 2 (hence base 2)

Decimal to Binary

Decimal 123 convert to binary

Step 1: figure out how many bits are needed to represent the number.

	128	64	32	16	8	4	2	1
	0							

Make your chart starting from the one's place, keep going until the base 2 place (digit) you are at is bigger than your decimal #. Put a 0 (off) in that base 2 place.

Step 2: Now work your way down. 64 is needed to makeup 123, so turn it on (1)

	128	64	32	16	8	4	2	1
	0	1						

Step 3: Figure out what is left of the decimal # 123 after we account for 64 of it
 $123 - 64 = 59$

Step 4: Compare what's left with the next digit (32)

If what's left is less than the next digit

-turn it off

if what's left is more than the digit

-turn it on

	128	64	32	16	8	4	2	1
	0	1	1					

Step 5: Find out what's left.

$$59 - 32 = 27$$

Step 6: Compare what's left with the next digit (16)

If what's left is less than the next digit

-turn it off

if what's left is more than the digit

-turn it on

	128	64	32	16	8	4	2	1
	0	1	1	1				

Step 7: Figure out what's left

$$27 - 16 = 11$$

Step 8: Compare what's left with the next digit (8)

If what's left is less than the next digit

-turn it off

if what's left is more than the digit

-turn it on

	128	64	32	16	8	4	2	1
	0	1	1	1	1			

Step 9: Figure out what's left

$$11 - 8 = 3$$

we'll finish it off in our heads

	128	64	32	16	8	4	2	1
	0	1	1	1	1	0	1	1

$$123 = 1\ 111\ 011_2$$

Octal (base 8)

digits possible: 0 1 2 3 4 5 6 7

starting with the 1 one's place, we go up in multiples of 8

512	64	8	1
8^3	8^2	8^1	8^0

Convert 123 to octal:

Step 1: Find the largest octal digit we need.

$123 < 512$, so we put a 0 for that digit

512	64	8	1
0			

Step 2: How many 8's are needed to make up 123?

$123 / 64 = 1.92$ (just take the whole number part)

512	64	8	1
0	1		

Step 3: What's left? $123 - 64 = 59$

Step 4: How many 8's are needed to make up 59?

$59/8 = 7.4$

512	64	8	1
0	1	7	

Step 5: What's left? $59 - 56 = 3$

Step 6:

512	64	8	1
0	1	7	3

$123 = 173_8$

Hexadecimal (Base 16)

There are 16 possible digits:

0 1 2 3 4 5 6 7 8 9 A B C D E F

So,

A=10

B=11

C=12

D=13

E=14

F=15

starting with the 1 one's place, we go up in multiples of 16

Convert 579 to Hexadecimal

Step 1: figure out how big your chart needs to be

$16 \times 16 = 256$	16	1
16^2	16^1	16^0

Step 2: how many 256's are in 579?

$$579/256 = 2.25$$

$16 \times 16 = 256$	16	1
16^2	16^1	16^0
2		

Step 3: Find out what's left

$$579 - 2(256) = 67$$

Step 4: how many 16's are needed to make up 67

$$67/16 = 4.1875$$

$16 \times 16 = 256$	16	1
16^2	16^1	16^0
2	4	

Step 5: Figure out what's left

$$67 - 4(16) = 3$$

Step 6: fill in the one's place

$16 \times 16 = 256$	16	1
16^2	16^1	16^0
2	4	3

Hex to Decimal

$16 \times 16 = 256$	16	1
16^2	16^1	16^0
A	B	C

$$ABC = 10 * 256 + 11 * 16 + 12 * 1 = 2748$$